

## Chapter IV: Verification and Validation Report

## **1.0 SCOPE OF VERIFICATION AND VALIDATION ACTIVITIES**

The overall verification and validation (V&V) effort for the FEHM application consists of rigorous and complete testing of the model, whenever possible, against known analytical solutions of the same problem. An alternative approach for more complex test cases for which no analytical solution exists is to benchmark the code against the results of other numerical models.

## **2.0 DESCRIPTION OF ENVIRONMENT**

Verification of the FEHM application was performed on the following UNIX platforms: Sun SPARC (SunOS4.3 and SunOS5.5), SGI (Irix 5.2 and 5.3), HP (HP-UX A.09.05), and IBM (AIX 2), but FEHM should work on any standard UNIX system.

A series of test scripts have been developed to automate the verification procedure. These scripts are described in more detail in the Appendix "FEHM Verification Scripts" in the FEHM "User's Manual" (Zyvoloski et al. 1997b).

## **3.0 ADDITIONAL VERIFICATION AND VALIDATION ISSUES**

This V&V effort attempts to test each of the major submodels in FEHM against an analytical solution or the results of another flow and transport code. Test cases for heat transfer, isothermal fluid flow, coupled heat and mass transfer, and solute transport are included. For any of these individual runs, there are numerous "minor" options available, such as input/output options, the ability to restart calculations, and the ability to set properties on a node-by-node or zone-by-zone basis that are not included in this report. These options have been extensively debugged, tested, and documented, but in the interest of space and time limitations, they are outside the scope of the formal testing effort.

Model validation is another area that is outside the scope of this report. A large field-testing effort is being undertaken in the Yucca Mountain Project to test the validity of the conceptual models and build confidence in them. However, these studies are scientific studies that are not covered in this document, which focuses only on code verification, the process of determining that the physical models have been properly implemented in the computer code.

## **4.0 DISCUSSION OF TEST RESULTS**

The problems discussed below correspond directly to those described in Section 4.0 of Chapter III, "Verification and Validation Plan."